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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/761,217	01/16/2001	Shailender Chaudhry	SUN-P3900-SPL	4812
22835	7590	01/12/2004	EXAMINER	
PARK, VAUGHAN & FLEMING LLP 508 SECOND STREET SUITE 201 DAVIS, CA 95616			O'BRIEN, BARRY J	
			ART UNIT	PAPER NUMBER
			2183	3
DATE MAILED: 01/12/2004				

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/761,217

Applicant(s)

CHAUDLHRY ET AL.

Examiner

Barry J. O'Brien

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 16 January 2001 and 07 February 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.  
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

### **DETAILED ACTION**

1. Claims 1-24 have been examined.

#### ***Papers Submitted***

2. It is hereby acknowledged that the following papers have been received and placed on record in the file: IDS as received on 2/7/2002.

#### ***Specification***

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

#### ***Claim Objections***

4. Claim 1 is objected to because of the following informalities:
  - a. Claim 1 recites on line 8 the limitation, "the speculative thread." There is no antecedent basis for this term. Please correct the claim language to provide antecedent basis for the term.
5. Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Marcuello et al., *Value Prediction for Speculative Multithreaded Architectures*, and further by Marcuello et al., *Speculative Multithreaded Processors*, incorporated by reference in Section 2 of *Value Prediction for Speculative Multithreaded Architectures*. The former article will herein be referenced as Marcuello(1), the latter as Marcuello(2).

8. Regarding claims 1, 12 and 23, taking claim 12 as exemplary, Marcuello has taught an apparatus that facilitates predicting a result produced by a section of code in order to support speculative program execution, the section of code including a plurality of program instructions (see Marcuello(2) Col.1 lines 11-16 and Col.2 line 47 – Col.3 line 9), the apparatus comprising:

- a. A head thread that is configured to execute the section of code within a program, wherein executing the section of code produces the result (see Marcuello(2) Col.5 lines 19-25),
- b. A prediction mechanism that is configured to generate a predicted result to be used in place of the result before the head thread produces the result (see Marcuello(2) Col.3 lines 2-9),
- c. A speculative thread that is configured to speculatively execute subsequent code within the program using the predicted result (see Marcuello(2) Col.3 lines 2-9 and Col.6 lines 14-20), wherein the subsequent code follows the section of code in an execution stream of the program (see Marcuello(2) Col.5 lines 26-29),

- d. A determination mechanism that is configured to determine if a difference between the predicted result and the result generated by the head thread affected the execution of the speculative thread (see Marcuello(2) Col.4 lines 53-57),
  - e. A joining mechanism that is configured to merge state associated with the speculative thread with state associated with the head thread if the difference did not affect execution of the speculative thread (see Marcuello(2) Col.4 lines 53 – Col.5 line 5 and Col.5 lines 26-35),
  - f. Wherein if the difference affected execution of the speculative thread, the apparatus is configured to execute the subsequent code again using the result generate by the head thread (see Marcuello(2) Col.8 lines 7-11).
9. Claims 1 and 23 are nearly identical to claim 12. Claim 1 differs in its lack of an apparatus to perform its method upon, but encompasses the same scope as claim 12. Claim 23 differs in it claiming a computer-readable storage medium storing instructions that when executed by a computer cause the computer to perform a method, which is taught by Marcuello (see Marcuello(1) “ICache” of Fig.1), but the method encompasses the same scope as claim 12. Therefore, claims 1 and 23 are rejected for the same reasons as claim 12.
10. Regarding claims 2, 13 and 24, taking claim 13 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein while executing the subsequent code again, the apparatus is configured to perform a rollback operation for the speculative thread to undo actions performed by the speculative thread (see Marcuello(2) Col.8 lines 7-11).

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11. Claims 2 and 24 are nearly identical to claim 13. They differ in their parent claims, but encompass the same scopes. Therefore, claims 2 and 24 are rejected for the same reasons as claim 13.

12. Regarding claims 3 and 14, taking claim 14 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein the determination mechanism is configured to determine if the speculative thread accessed the predicted result. Here, Marcuello has taught the comparing of the results of the head thread and the speculative thread, and either rolling back the speculative thread to be re-executed if the results were not equal (see Marcuello(2) Col.8 lines 7-11), or committing the thread if the results were the same (see Marcuello(2) Col.4 lines 53-57). The Applicant's specification describes this problem of a memory element having been read by the speculative result when it should have first been written by the head thread, causing erroneous results, and consequently either rolling back the speculative thread so it can be re-executed if there was a problem, or committing the thread if there was no problem (p.10 lines 3-23 of the specification). Therefore, Marcuello is inherently operating in the same manner as the claim language has stated, in that if the speculative thread incorrectly reads the result of a write operation, it would produce erroneous results that would be detected in the thread comparison of Marcuello and consequently perform the correct action.

13. Claim 3 is nearly identical to claim 14, differing in its parent claim, but encompassing the same scope. Therefore, claim 3 is rejected for the same reasons as claim 14.

14. Regarding claims 4 and 15, taking claim 15 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein the determination mechanism is configured to

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determine if the predicted result differs from the result generated by the head thread (see Marcuello(2) Col.4 lines 53-57).

15. Claim 4 is nearly identical to claim 15, differing in its parent claim, but encompassing the same scope. Therefore, claim 4 is rejected for the same reasons as claim 15.

16. Regarding claims 5 and 16, taking claim 16 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein the prediction mechanism is configured to generate the predicted result by looking up a value based upon a program counter for the program. (see Marcuello(1) Col.7 lines 14-20).

17. Claim 5 is nearly identical to claim 16, differing in its parent claim, but encompassing the same scope. Therefore, claim 5 is rejected for the same reasons as claim 16.

18. Regarding claims 6 and 17, taking claim 17 as exemplary, Marcuello has taught the apparatus of claim 16 as shown above, wherein the prediction mechanism is configured to generate the predicted result by additionally looking up the valued based upon at least one previously generated value for the result (see Marcuello(1) Col.5 lines 22-38).

19. Claim 6 is nearly identical to claim 17, differing in its parent claim, but encompassing the same scope. Therefore, claim 6 is rejected for the same reasons as claim 17.

20. Regarding claims 7 and 18, taking claim 18 as exemplary, Marcuello has taught the apparatus of claim 16 as shown above, wherein the prediction mechanism is configured to generate the predicted result by performing a function on the value (see Marcuello(1) Col.5 lines 28-31).

21. Claim 7 is nearly identical to claim 18, differing in its parent claim, but encompassing the same scope. Therefore, claim 7 is rejected for the same reasons as claim 18.

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22. Regarding claims 8 and 19, taking claim 19 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein the section of code includes one of, a method, a function, and a procedure (see Marcuello(1) Col.3 lines 24-33).

23. Claim 8 is nearly identical to claim 19, differing in its parent claim, but encompassing the same scope. Therefore, claim 8 is rejected for the same reasons as claim 19.

24. Regarding claims 9 and 20, taking claim 20 as exemplary, Marcuello has taught the apparatus of claim 12 as shown above, wherein the section of code is a body of a loop in the program, and the result is a loop carried dependency for the loop (see Marcuello(1) Col.4 line 37 – Col.5 line 7).

25. Claim 9 is nearly identical to claim 20, differing in its parent claim, but encompassing the same scope. Therefore, claim 9 is rejected for the same reasons as claim 20.

26. Regarding claims 10 and 21, taking claim 21 as exemplary, Marcuello has taught the apparatus of claim 12, further comprising a mechanism that performs write operations for the head thread, the mechanism being configured to:

- a. Perform a write operation to a primary version of a memory element,
- b. Check status information associated with the memory element to determine if the memory element has been read by the speculative thread,
- c. Cause the speculative thread to roll back so that the speculative thread can read a result of the write operation if the memory element has been read by the speculative thread,



- d. Perform the write operation to a space-time dimensioned version of the memory element if the space-time dimensioned version exists and if the memory element has not been read by the speculative thread.

27. Here, Marcuello has taught the comparing of the results of the head thread and the speculative thread, and either rolling back the speculative thread to be re-executed if the results were not equal (see Marcuello(2) Col.8 lines 7-11), or committing the thread if the results were the same (see Marcuello(2) Col.4 lines 53-57). The Applicant's specification describes this problem of a memory element having been read by the speculative result when it should have first been written by the head thread, causing erroneous results, and consequently either rolling back the speculative thread so it can be re-executed if there was a problem, or committing the thread if there was no problem (p.10 lines 3-23 of the specification). Therefore, Marcuello is inherently operating in the same manner as the claim language has stated, in that if the speculative thread incorrectly reads the result of a write operation, it would produce erroneous results that would be detected in the thread comparison of Marcuello and consequently perform the proper action.

28. Claim 10 is nearly identical to claim 21, differing in its parent claim, but encompassing the same scope. Therefore, claim 10 is rejected for the same reasons as claim 21.

29. Regarding claims 11 and 22, taking claim 22 as exemplary, Marcuello has taught the apparatus of claim 21 as shown above, wherein the joining mechanism is configured to:

- a. Merge the space-time dimensioned version of the memory element into the primary version of the memory element (see Marcuello(2) Col.5 lines 2-5),

- b. Discard the space-time dimensioned version of the memory element (see Marcuello(2) Col.8 lines 31-46).

30. Claim 11 is nearly identical to claim 22, differing in its parent claim, but encompassing the same scope. Therefore, claim 11 is rejected for the same reasons as claim 22.

### ***Conclusion***

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Applicant is reminded that in amending in response to a rejection of claims, the patentable novelty must be clearly shown in view of the state of the art disclosed by the references cited and the objections made. Applicant must also show how the amendments avoid such references and objections. See 37 CFR § 1.111(c).

32. Marcuello et al., *Clustered Speculative Multithreaded Processors*, has taught the execution of simultaneous threads from the same program using control speculation and data value prediction.

33. Marcuello et al., *Data Speculative Multithreaded Architecture*, has taught the spawning of speculative threads from a single-threaded application, and the subsequent simultaneous execution of the threads.

34. Sharangpani et al., U.S. Patent No. 6,065,115, has taught a processor speculatively executing instructions from multiple threads, as well as using branch prediction to determine if the condition of the thread is likely to be predicted correctly, committing the results of the speculative executions when correct.

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35. Kranich et al., U.S. Patent No. 6,574,725, has taught a processor for speculatively executing multiple threads of instruction simultaneously.

36. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Barry J. O'Brien whose telephone number is (703) 305-5864.

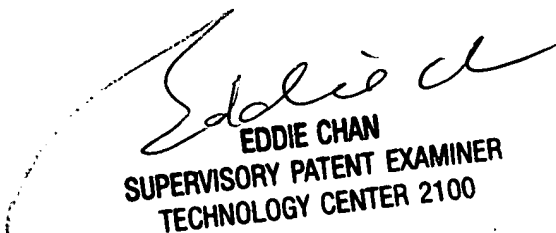
The examiner can normally be reached on Mon.-Fri. 7am-4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (703) 305-9712. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 305-3900.

Barry J. O'Brien  
Examiner  
Art Unit 2183

BJO  
1/9/2004

  
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